

Claims

- [c1] . A photochromic matrix layer composition comprising:
a monomer mixture comprising a flexible hydrophilic dimethacrylate monomer, a hydrophobic monomer, a flexible hydrophobic multi(meth)acrylate monomer, and a urethane methacrylate oligomer, wherein the multi(meth)acrylate monomer contains three or more methacrylate groups or acrylate groups; and
a photochromic dye.
- [c2] 2. The composition of claim 1, comprising two or more hydrophobic monomers.
- [c3] 3. The composition of claim 1, comprising two or more urethane methacrylate oligomers.
- [c4] 4. The composition of claim 1, comprising two or more photochromic dyes.
- [c5] 5. The composition of claim 1, wherein the flexible hydrophilic dimethacrylate monomer is a polyethylene glycol dimethacrylate, a urethane dimethacrylate, an epoxy dimethacrylate, or a polyester dimethacrylate.
- [c6] 6. The composition of claim 1, wherein the flexible hy-

drophilic dimethacrylate monomer is polyethylene glycol (400) dimethacrylate.

- [c7] 7. The composition of claim 1, wherein the flexible hydrophilic dimethacrylate monomer is present at a concentration of about 20 weight percent to about 50 weight percent of the monomer mixture.
- [c8] 8. The composition of claim 1, wherein the hydrophobic monomer is a monomethacrylate, a dimethacrylate, a trimethacrylate, or combinations thereof.
- [c9] 9. The composition of claim 1, wherein the hydrophobic monomer is isobornyl methacrylate, 1,12-dodecanediol dimethacrylate, tridecyl methacrylate, or combinations thereof.
- [c10] 10. The composition of claim 1, wherein the hydrophobic monomer is present at a concentration of about 5 weight percent to about 50 weight percent of the monomer mixture.
- [c11] 11. The composition of claim 1, wherein the flexible hydrophobic multi(meth)acrylate monomer is bis(trimethylolpropane) tetramethacrylate, an alkoxyated trimethylolpropane trimethacrylate, an alkoxyated bis(trimethylolpropane) tetramethacrylate, a urethane methacrylate with three or more methacrylate groups, an

epoxy methacrylate with three or more methacrylate groups, a polyester methacrylate with three or more methacrylate groups, or mixtures thereof.

[c12] 12. The composition of claim 1, wherein the flexible hydrophobic multi(meth)acrylate monomer is bis(trimethylolpropane) tetraacrylate.

[c13] 13. The composition of claim 1, wherein the flexible hydrophobic multi(meth)acrylate monomer is trimethylolpropane trimethacrylate.

[c14] 14. The composition of claim 1, wherein the flexible hydrophobic multi(meth)acrylate monomer is present at a concentration of about 5 weight percent to about 20 weight percent of the monomer mixture.

[c15] 15. The composition of claim 1, wherein the urethane methacrylate oligomer is a polyether urethane dimethacrylate, a polyether urethane trimethacrylate, or mixtures thereof.

[c16] 16. The composition of claim 1, wherein the urethane methacrylate oligomer is present at a concentration of about 15 weight percent to about 60 weight percent of the monomer mixture.

[c17] 17. The composition of claim 1, wherein the pho-

tochromic dye is CNN7, CNN8, CNN9, Reversacol Ruby Red, Reversacol Corn Yellow, or mixtures thereof.

- [c18] 18. The composition of claim 1, wherein the photochromic dye is present at a concentration of about 0.002 weight percent to about 0.15 weight percent of the composition.
- [c19] a9a The composition of claim 1, containing 2, 3, 4, or 5 photochromic dyes.
- [c20] 20. The composition of claim 19, wherein each of the dyes are independently present at a concentration of about 0.002 weight percent to about 0.15 weight percent of the composition.
- [c21] 21. The composition of claim 1, further comprising a polymerization initiator.
- [c22] 22. The composition of claim 21, wherein the polymerization initiator is Irgacure 819, Irgacure 2020, or Perkadox AMBN.
- [c23] 23. The composition of claim 21, wherein the polymerization initiator is present at a concentration of about 0.06 weight percent to about 2.0 weight percent based on the weight of the composition.
- [c24] 24. The composition of claim 1, characterized by having

a viscosity of about 10 cps to about 24,000 cps at 25 °C.

[c25] 2a The composition of claim 1, further comprising a fixed dye.

[c26] 26. The composition of claim 25, wherein the fixed dye is Sudan Blue 670, Keyplast Magenta M6B, Keyplast Violet 3B, or Keyplast Oil Violet IRS.

[c27] 27. The composition of claim 1, wherein:
the flexible hydrophilic dimethacrylate monomer is polyethylene glycol (400) dimethacrylate;
the hydrophobic monomer is isobornyl methacrylate, 1,12-dodecanediol dimethacrylate, or tridecyl methacrylate;
the flexible hydrophobic multi(meth)acrylate monomer is trimethylolpropane trimethacrylate; and
the urethane methacrylate oligomer is a polyether urethane dimethacrylate or a polyether urethane trimethacrylate.

[c28] a8a A tie coating composition comprising a methacrylate monomer, a (meth)acrylated oligomer with a polycarbonate backbone, a urethane methacrylate oligomer, and a solvent.

[c29] 29. The composition of claim 28, comprising two or more methacrylate monomers.

- [c30] 30. The composition of claim 28, comprising two or more urethane methacrylate oligomers.
- [c31] 31. The composition of claim 28, wherein the methacrylate monomer is isobornyl methacrylate, tetrahydrofurfural methacrylate, a polyethyleneglycol dimethacrylate, or methylmethacrylate.
- [c32] 32. The composition of claim 28, wherein the methacrylate monomer is tetrahydrofurfural methacrylate.
- [c33] 33. The composition of claim 28, wherein the methacrylate monomer is present at a concentration of about 5 weight percent to about 25 weight percent of the non-volatile components of the composition.
- [c34] 34. The composition of claim 28, wherein the (meth)acrylated oligomer with a polycarbonate backbone is Sartomer CN9001.
- [c35] 35. The composition of claim 28, wherein the (meth)acrylate oligomer with a polycarbonate backbone is present at a concentration of about 20 weight percent to about 50 weight percent of the non-volatile components of the composition.
- [c36] 36. The composition of claim 28, wherein the urethane methacrylate oligomer is a dimethacrylate or a

trimethacrylate.

- [c37] a7a The composition of claim 28, wherein the urethane methacrylate oligomer is a polyether urethane dimethacrylate or a polyether urethane trimethacrylate.
- [c38] 38. The composition of claim 37, wherein the polyether urethane dimethacrylate is present at a concentration of about 20 weight percent to about 50 weight percent of the non-volatile components of the composition.
- [c39] 39. The composition of claim 37, wherein the polyether urethane trimethacrylate is present at a concentration of about 15 weight percent to about 40 weight percent of the non-volatile components of the composition.
- [c40] 40. The composition of claim 28, wherein the solvent comprises a ketone.
- [c41] 41. The composition of claim 28, wherein the solvent is a solvent mixture.
- [c42] 42. The composition of claim 28, wherein the solvent is a mixture of isopropyl alcohol and methyl ethyl ketone.
- [c43] 43. The composition of claim 28, further comprising a polymerization initiator.
- [c44] a4a A method of preparing a photochromic polycarbon-

ate lens, the method comprising:
providing a polycarbonate lens blank;
applying a tie coating composition to the lens blank, the tie coating composition comprising a methacrylate monomer, a (meth)acrylated oligomer with a polycarbonate backbone, a urethane methacrylate oligomer, and a solvent;
allowing the solvent to evaporate to form a tie coating layer;
partially polymerizing the tie coating layer;
applying a photochromic matrix layer composition to the tie coating layer, the photochromic matrix layer composition comprising a monomer mixture comprising a flexible hydrophilic dimethacrylate monomer, a hydrophobic monomer, a flexible hydrophobic multi(meth)acrylate monomer, and a urethane methacrylate oligomer, wherein the multi(meth)acrylate monomer contains three or more methacrylate groups or acrylate groups; and a photochromic dye; and
polymerizing the tie coating layer and the photochromic matrix layer composition to prepare a photochromic polycarbonate lens.

[c45] 45. The method of claim 44, wherein the applying a tie coating composition step comprises flow coating, dip coating, or spin coating.

- [c46] 46. The method of claim 44, wherein the applying a tie coating composition step comprises spin coating.
- [c47] 47. The method of claim 44, wherein the tie coat layer is about 8 microns to about 16 microns in thickness.
- [c48] 48. The method of claim 44, wherein the partially polymerizing step comprises exposing the tie coating layer to UV light of about 600 mJ/cm^2 to about 2000 mJ/cm^2 .
- [c49] 49. The method of claim 44, wherein the partially polymerizing step comprises exposing the tie coating layer to UV light of about 800 mJ/cm^2 to about 1300 mJ/cm^2 .
- [c50] 50. The method of claim 44, comprising applying two or more tie coating layers to the lens blank.
- [c51] 51. The method of claim 44, further comprising drying the lens blank and tie coating layer by exposure to a radiant IR source.
- [c52] a2a The method of claim 44, further comprising drying the lens blank and tie coating layer by heating to about 120°F (49°C) to about 200°F (93°C) prior to the step of applying the photochromic matrix layer composition.
- [c53] 53. The method of claim 52, wherein the heating step is performed in a dry air atmosphere or a nitrogen atmo-

sphere.

- [c54] 54. The method of claim 44, further comprising heating the photochromic matrix composition to about 120 °F (49 °C) to about 150 °F (66 °C) prior to the step of applying the photochromic matrix layer composition to the tie coating layer.
- [c55] 55. The method of claim 44, further comprising placing the lens blank in a mold after the partially polymerizing step and prior to applying the photochromic matrix layer, wherein the mold contains a gasket or tape having a liquid tight seal when placed on the concave side of the mold.
- [c56] 56. A method of preparing a photochromic polycarbonate lens, the method comprising:
providing a polycarbonate lens blank;
applying a tie coating composition to the lens blank, the tie coating composition comprising a methacrylate monomer, a (meth)acrylated oligomer with a polycarbonate backbone, a urethane methacrylate oligomer, and a solvent;
allowing the solvent to evaporate to form a tie coating layer;
partially polymerizing the tie coating layer;
providing a mold;

applying a photochromic matrix layer composition to the tie coating layer in the mold, the photochromic matrix layer composition comprising a monomer mixture comprising a flexible hydrophilic dimethacrylate monomer, a hydrophobic monomer, a flexible hydrophobic multi(meth)acrylate monomer, and a urethane methacrylate oligomer, wherein the multi(meth)acrylate monomer contains three or more methacrylate groups or acrylate groups; and a photochromic dye; and polymerizing the tie coating layer and the photochromic matrix layer composition to prepare a photochromic polycarbonate lens; and removing the photochromic polycarbonate lens from the mold.